



Memorandum

To: Cristina Trott, FEMA Region III

From: Dana Boyadjian

Date: May 23, 2019

*Subject: Updated Technical Feasibility and BCA Technical Review – DR-4273 –
Subapplication 53: State EOC Hardening Project*

Additional documentation was received from the subapplicant on January 29, 2019. An analysis of this additional documentation was performed, and new commentary summarizing our findings is indicated in ***bold italic text*** below.

Background

The West Virginia Division of Homeland Security and Emergency Management (WVDHSEM) is proposing to structurally upgrade the existing Drill Hall located within the West Virginia National Guard Armory Building to create a community multi-use safe room for the State Emergency Operations Center (EOC). The Drill Hall is currently used for drill exercises and assemblies but is an ideal site for a safe room due to its size, open floor plan, and location outside of the special flood hazard area. The current state EOC is in the basement of the Capitol Complex Building One, approximately 3.5 miles from the proposed safe room site. Although the current EOC does not appear to be in a special flood hazard area per the current FEMA FIRM map, its proximity to the Kanawha River renders it vulnerable to flooding. The subapplicant also indicates the current EOC is susceptible to terror incidents, access impediments, and cannot support operations due to limitations in spacing. The new safe room will strengthen the community's assets and protect inhabitants during and after a catastrophic event.

Feasibility and Effectiveness

The proposed safe room will be designed to meet or exceed the standards set forth in FEMA P-361 (*Safe Rooms for Tornadoes and Hurricanes*), as required for HMGP funding. While detailed structural designs have not been prepared yet, the subapplicant expects to upgrade the envelop of the structure by reinforcing the roof, hardening walls, upgrading and retrofitting the windows to protect against winds, ensuring fire resistant and water tight doors, and upgrading utilities and backup generator equipment. Provided the design will meet FEMA P-361 standards, the proposed safe room is expected to achieve near absolute protection.

As a hardened EOC safe room, the proposed project is expected to provide at least 2 hours of protection in tornado events, as per FEMA P-361 requirements. While the subapplicant has not indicated the period of protection, it should be noted that this timeframe should be verified. In addition, any ancillary equipment required to operate during an event for the safe room must also be properly sized and protected to the same level as the safe room. Doors and windows should be designed to withstand windborne debris missile impacts.

A preliminary conceptual layout of the proposed safe room has been provided by the subapplicant. The layout shows the existing space within the Drill Hall being converted to a two-floor multi-use safe room consisting of partitioned storage rooms, conference rooms, offices, and a large classroom or auditorium. Specific dimensions are not provided, but it appears the first-floor footprint is the same as that of the existing Drill Hall (100 ft x 70 ft), while the second floor footprint is slightly smaller than this. The subapplicant should provide detailed dimensions for both floors, as this information is relevant to complete the benefit-cost analysis.

An estimated budget was provided by the subapplicant but appears to include lump sum costs for various phases of the project and does not include all aspects of the project, including but not limited to project management fees, project scoping, and construction costs.

The subapplicant provided new documentation pertaining to occupants of the EOC safe room that would be protected in the event of a tornado. The documentation indicates a total service population of 2,014 persons. This occupancy includes WV Army Guard personnel, WV Air Guard personnel, WVMA Civ personnel, DHSEM personnel, Airport personnel, Airport customers, and local residents within a 0.5-mile radius of the proposed EOC safe room.

Review

A Benefit-Cost Analysis (BCA) has not been performed by the subapplicant yet, but several initial observations were made with respect to the information provided to date. The below parameters are necessary inputs to evaluate the benefits and costs using the Tornado Safe Room module. The benefits in this module are based solely on providing life safety benefits for the safe room occupants. The benefits (avoided losses) represent the difference between injuries that would occur without the safe room and the reduced injuries after the safe room is constructed. The injuries before mitigation (safe room construction) are determined based on potential damage to the building types that potential occupants would be taking refuge during the storm.

- **Project useful life:** The subapplicant did not provide a project useful life, but the FEMA standard value of 30 years can be used for a community safe room project. If a value other than the standard value is used, documentation and justification are required.
- **Project cost:** The subapplicant indicates an estimated project cost of \$5,000,000. However, this cost is based on lump sum costs for various phases of the project. A detailed cost-estimate with line items, quantities, and unit costs is necessary to substantiate the project cost. The subapplicant should aim to develop a well-documented project cost estimate with

detailed, line-item costs. It should contain quantities, unit costs, and a source for each unit cost to accurately reflect the total project cost. The subapplicant should also be aware of eligible and ineligible costs for safe room projects. Eligible costs should include only the project components related directly to and necessary for providing immediate life-safety protection. Additional information on eligible costs can be referenced in Section C.4.3 of the Addendum to the Hazard Mitigation Assistance Guidance.

- **Annual maintenance costs:** Annual maintenance costs were not specified.
- **Safe room maximum occupancy:** The subapplicant does not provide the safe room maximum occupancy. The maximum occupancy for a community tornado safe room is based on the type of occupant and usable floor area.

The maximum occupancy is identified as the population expected to seek refuge in the proposed safe room. This is indicated as 2,014 persons and represents the population within a 0.5-mile radius of the proposed safe room. While the subapplicant provides a list of population sources, it is unclear where the occupancy numbers were obtained from. No records were provided to validate the number of persons coming from each source.

In addition, it should be noted that per FEMA P-361 requirements, there are limitations to the travel time needed for all protected occupants to reach the safe room. In particular, occupants must have a maximum walking travel time of 5 minutes or a maximum driving travel distance of approximately 0.5 miles to reach the safe room. With the large number of protected occupants, it may be difficult for all occupants to safely enter the safe room in this short timeframe.

- **Gross area (sqft) of the safe room:** The gross area of the safe room is the total area from wall to wall for the portion of the building used as a safe room. The footprint of the Drill Hall, or the first floor of the proposed multi-use safe room, is 7,000 sqft. This square footage was confirmed by the as-built drawings provided by the subapplicant. However, the square footage of the second floor of the proposed safe room should be provided by the subapplicant. The total gross area of the safe room will be 7,000 sqft plus the square footage of the second floor.
- **Usable area (sqft) of the safe room:** The usable area (sqft) of the safe room was not provided by the subapplicant. The total gross area of the safe room should be reduced accordingly to account for the usable area.

The identified service population of 2,014 occupants directly affects the proposed safe room design size. The anticipated population that will use the safe room must be carefully considered, so sufficient space is afforded to the occupants. Funding is not provided for safe rooms that are larger than the size required to accommodate the

identified population. From a design and construction standpoint, there is no limitation on the maximum population that a safe room may be designed to protect.

The usable floor area should allow for appropriate space requirements for various safe room occupants, such as standing or seated occupants (5 sqft required), wheelchair-bound occupants (10 sqft required), and bedridden occupants (30 sqft required). In addition, per FEMA P-361 guidelines, a community safe room should have space for one wheelchair-bound occupant for every 200 occupants.

While the usable area of the safe room has not been provided by the subapplicant, a preliminary value can be calculated and used for guidance based on the maximum occupancy of 2,014 persons.

For 2,014 occupants, the safe room should accommodate at least 10 wheelchair-bound occupants, per FEMA P-361 requirements.

- *10 wheelchair-bound occupants x 10 sqft = 100 sqft.*

There should also be at least 5 sqft of minimum usable space for the remaining standing or seating occupants.

- *Remaining occupants = 2,014 - 10 = 2,004 occupants.*
- *2,004 occupants x 5 sqft = 10,020 usable sqft.*

Therefore, the minimum usable area of the safe room should be at least 100 sqft + 10,020 sqft = 10,120 sqft. Given that the safe room will have two floors, it is likely there will be sufficient usable area, as the second floor appears to consist of a significant amount of space. However, this value of 10,020 sqft should be confirmed with usable area provided by the subapplicant (when available) to determine if the safe room is sufficiently sized to support the required space for the service population.

- **Design wind speed:** The subapplicant indicates the safe room will be designed to withstand winds of 250 mph, as per the "Safe Room Design Wind Speeds for Tornados" map in Figure B3-1 of FEMA P-361. Based on the location of the proposed safe room and reference to this map, the appropriate design wind speed is 200 mph.
- **Safe room service radius:** The subapplicant does not specify the size of the community that will use the safe room. The FEMA standard value of 0.5 miles can be used if additional justification is not provided.

The safe room service radius is identified as 0.5 miles. This radius represents a maximum 0.5-mile travel distance or maximum walking travel time of 5 minutes for safe room occupants to reach the safe room.

- **Predominant structure types that people will leave to go to the safe room:** The subapplicant does not indicate the predominant structure types, but a preliminary assessment of buildings within a 0.5-mile radius of the Drill Hall indicates that institutional buildings (government facilities) and one- or two- family residences are the predominant structure types.

The predominant structure type that people will leave to go to the safe room appears to be institutional buildings. Personnel using the safe room are expected to leave from the WV Army Guard (360 people), WV Air Guard (1,128 people), WVMA Civ (216 people), DHSEM (75 people), and the Airport (35 people). In addition, 75 Airport customers are expected to use the safe room. A small number of local residents (125 people) are also expected to utilize the safe room. Although the subapplicant's documentation does not explicitly identify the residential structure type for these local residents, an assessment using publicly-available online mapping services indicates these residents appear to come from one- or two- family residences.

- **Percent of total occupancy coming from each structure type:** The subapplicant does not specify occupancy percentages coming from each structure type during the day (6:00am-6:00pm), night (midnight-6:00am), and evening (6:00pm-midnight).

Although the population that would seek refuge in the safe room has been identified, the documentation does not indicate what percent of total occupancy is expected to come from each structure type (institutional buildings and one- or two- family residences) during the three-time segments (day, night, and evening). Knowing the percentage of occupants who will be coming from each structure type is important because each structure type has a different wind performance. This data input helps determine the number of casualties prevented.

Summary and Concerns with Documentation

While the project appears to be necessary, additional information is required to confirm technical feasibility and cost-effectiveness. The following issues were identified when reviewing the application:

- An Operations and Maintenance (O&M) Plan is required. The subapplicant should describe the approach use to prepare the O&M Plan and include a written statement acknowledging the requested community safe room will be operated and maintained in a manner that supports the mitigation project. The plan should be consistent with guidance provided in FEMA P-361.
- Certification from a licensed Professional Engineer or Registered Architect that the project meets or exceeds FEMA P-361 standards. At a minimum, the subapplicant should include an affirmative statement that the project will be designed and constructed to meet or exceed these standards.

- Given that the EOC safe room will likely be designed for more than 50 occupants, peer review by an independent registered design professional will be required to verify conformance with the design criteria set forth in FEMA P-361.
- In order to complete the BCA, the subapplicant should provide documentation for the project cost (via a detailed project cost estimate), annual maintenance costs, safe room maximum occupancy, gross area of the safe room, usable area of the safe room, safe room service radius (if different from 0.5 miles), predominant structure types from which safe room occupants will be coming from (within the service radius), and occupancy percentages throughout the day for each predominant structure type.

The safe room maximum occupancy, safe room service radius, and predominant structure types have been provided with the additional information received from the subapplicant.

Conclusions and Recommendations

Based on the provided information, additional clarifications are needed to verify the technical feasibility and to evaluate the cost effectiveness of the project. We recommend requesting the following information:

- If the subapplicant intends to use a project useful life other than the FEMA standard value of 30 years, documentation and justification should be provided to support the value used.
- A detailed project cost-estimate with line items, quantities, unit costs, and sources for the unit costs is necessary to substantiate the estimated project cost of \$5,000.000. The current cost estimate appears to be based on lump sum costs for various phases of the project.
- Documentation for annual maintenance costs necessary for the upkeep or repair of safe room and associated components is necessary.
- The subapplicant should provide documentation for the safe room maximum occupancy. The maximum occupancy for a community tornado safe room is based on the type of occupant and usable floor area. For example, each standing or seated occupant requires a minimum of 5 sqft of usable floor area. Wheelchair-bound occupants require a minimum of 10 sqft each, and bedridden occupants require a minimum of 30 sqft each. In addition, the safe room must have space for at least one wheelchair-bound occupant for every 200 occupants. The occupancy data will also depend on the expected safe room occupants within the response distance (i.e., the radius surrounding the safe room for which the safe room is expected to service).

The safe room maximum occupancy has been identified as 2,014. The subapplicant should also provide documentation to verify that the protected population of 2,014

persons can meet the 5-minute time travel frame, as it may be difficult for this large number of people to safely enter the safe room in this short period and access considerations for the WV Guard facility may significantly impact the ability of local residents or airport customers to access the safe room.

- The subapplicant should provide detailed overall dimensions for the first and second floors of the proposed safe room. This information is necessary to determine the gross floor area.
- The subapplicant should provide detailed dimensions for all partitioned spaces on the first and second floors of the proposed safe room. This information is necessary to determine the usable floor area. The usable floor area should be determined by subtracting from the gross floor area of excluded spaces, partitions and walls, columns, fixed or movable objects, furniture, equipment, and other items that cannot be removed or stored during use as a safe room. The usable area should not include unused spaces or areas that are normally locked, such as mechanical rooms, storage closets, or offices. Additional guidance for calculating the usable area can be referenced in FEMA P-361.
- The subapplicant should confirm the safe room design wind speed to be used. While the subapplicant indicates the safe room will be designed to withstand 250 mph winds, the subapplicant should be aware that the minimum requirement is 200 mph based on the project location. It is important to note that designing the safe room to withstand 250 mph winds will likely result in increased costs and therefore, a reduction in the benefit-cost ratio.
- The subapplicant should specify the percent of total occupancy coming from each predominant structure type. Occupancy percentages coming from each structure type during the day (6:00am-6:00pm), night (midnight-6:00am), and evening (6:00pm-midnight) should be documented. The percentage of occupancy during at least one of these three time periods should equal 100 percent.

Safe room maximum occupancy: *	<input type="text"/>	
Enter the percent of the total occupancy coming from each structure type. Occupancy percentage total must equal 100% for at least one time period. *		
Time	Institutional	Totals
Day 6:00 AM - 6:00 PM	0	
Evening 6:00 PM - Midnight	0	
Night Midnight - 6:00 AM	0	

It should be noted that a follow-up RFI letter was issued from FEMA to WVDHSEM on August 10, 2018. The letter reiterated the need for the following information, which was initially requested from the subapplicant on May 23, 2018:

- Value of structure

- Historical damages (specifically wind damages from past years)
- Annual expenditures
- Displacement costs
- Property packet (including VPA, acknowledgement of conditions, and hazardous materials survey)
- CD with photos of the structure interior
- Footprint of the structure, identifying area to be retrofitted

While the BCA analysis focuses primarily on life-safety benefits, some of this information may be helpful toward investigating additional benefits for the BCA, should the project not achieve a passing benefit-cost ratio of 1.0 or greater.